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## NUMBER THEORY AND DIOPHANTINE ANALYSIS.

**203. Proposed by R. D. CARMICHAEL, Indiana University.**Find solutions in integers of the equation  $2x^2 + 1 = 3y^2$ .**204. Proposed by E. T. BELL, New York City.**

Show that a necessary and sufficient condition that  $6n + 1$  be a prime number is that no one of the quantities  $(3n - r)/(2r + 1)$  for  $r = 1, 2, 3, \dots, n - 1$  be an integer; similarly for  $6n - 1$ , the quantities being  $(3n - r)/(2r - 1)$  for  $r = 2, 3, 4, \dots, n$ .

## SOLUTIONS OF PROBLEMS.

## ALGEBRA.

**389. Proposed by W. W. BEMAN, University of Michigan.**If  $e^x = 1 + a_1x + a_2x^2 + a_3x^3 + \dots$ , prove that

$$na_n = \sum_{k=1}^{k=n} \frac{1}{(k-1)!} a_{n-k} \quad \text{or} \quad n! a_n = \sum_{k=1}^{k=n} \frac{(n-1)!}{(k-1)!} a_{n-k}.$$

SOLUTION BY A. M. HARDING, University of Arkansas.

We shall assume that the series

$$e^{e^x} = a_0 + a_1x + a_2x^2 + a_3x^3 + \dots$$

may be differentiated term by term. We then obtain

$$e^x \cdot e^{e^x} = a_1 + 2a_2x + 3a_3x^2 + \dots + na_nx^{n-1} + \dots$$

or

$$\left(1 + \frac{x}{1!} + \frac{x^2}{2!} + \dots + \frac{x^{n-1}}{(n-1)!} + \dots\right) \left(a_0 + a_1x + a_2x^2 + \dots + a_{n-1}x^{n-1} + \dots\right) \\ = a_1 + 2a_2x + 3a_3x^2 + \dots + na_nx^{n-1} + \dots.$$

Multiply the two series and equate coefficients of like powers of  $x$ . We then have

$$a_1 = a_0,$$

$$2a_2 = a_1 + \frac{a_0}{1!},$$

$$3a_3 = a_2 + \frac{a_1}{1!} + \frac{a_0}{2!},$$

$$4a_4 = a_3 + \frac{a_2}{1!} + \frac{a_1}{2!} + \frac{a_0}{3!},$$

$$\dots = \dots$$

$$na_n = a_{n-1} + \frac{a_{n-2}}{1!} + \frac{a_{n-3}}{2!} + \frac{a_{n-4}}{3!} + \dots + \frac{a_0}{(n-1)!}$$

$$= \sum_{k=1}^{k=n} \frac{1}{(k-1)!} a_{n-k}.$$

Solved similarly by A. L. McCARTY and ELMER SCHUYLER.